THE STRUCTURE OF TIDAL MIXING ON GEORGES BANK

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Our work to date has consisted of two parts. In part one microstructure and acoustic Doppler current profiler data are used to parameterize the bottom stress in terms of a quadratic drag coefficient, and to estimate the vertical extent of the near-bottom constant stress layer. Semidiurnal tidal phase-averaged profiles of turbulent kinetic energy dissipation rate, ϵ, derived from velocity shear data, were used to produce friction velocity, u_*, profiles at various times throughout the tidal cycle at each site for both field studies. These u_* profiles were used to estimate the bottom stress and the vertical extent of the constant stress layer. The drag coefficient was computed from the bottom stress and current magnitude at 12 m height above the bottom. At the shallow site, the drag coefficient varied from $0.6 \mathrm{x} 10^{-3}$ to $1.3 \mathrm{x} 10^{-3}$. At the deep site, a range of $0.6 \mathrm{x} 10^{-3}$ to $0.9 \mathrm{x} 10^{-3}$ was observed. The drag coefficient decreased with increasing current speed at both sites (Figure 1).

In Part Two, the measurements are used to study the vertical structure of turbulent mixing on the bank (Figure 2). At both sites the dominant variability in the turbulent kinetic energy dissipation rate, ϵ, was related to the semi-diurnal, M_2, tide. In the well-mixed portions of the water column a phase delay between ϵ and the current speed which increased with height above the bottom was observed. Analysis of the vertical structure of the M_2 tide shows that a phase lag between tidal velocity and vertical shear exists and has a depth dependence which is similar to that of the ϵ-speed phase lag. A simple, one-dimensional tidal model also produces a shear-velocity phase lag. Both the data analysis and the model results can be explained in terms of the analytical solution to the horizontal equations of motion with constant eddy viscosity, forced by a oscillating pressure gradient.

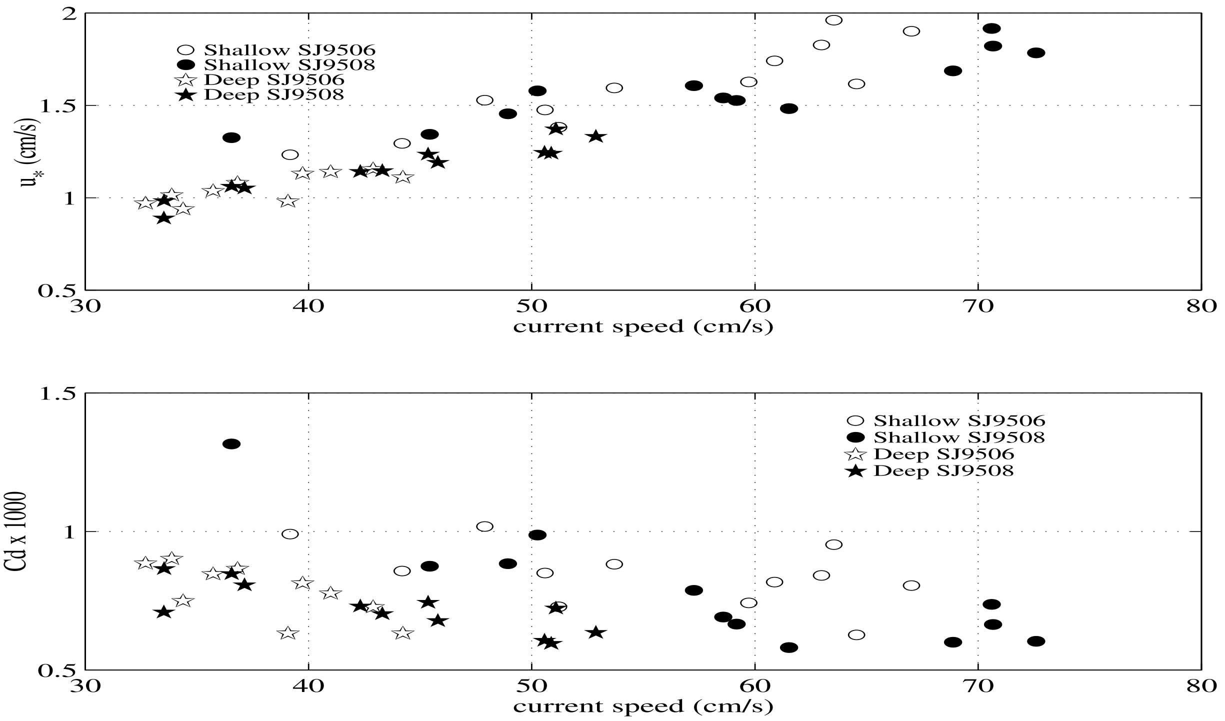

Figure 1: Upper panel: Bottom stress in terms of friction velocity versus phase-averaged speed at 12 m above the bottom. Lower panel: Drag coefficient versus phase-averaged velocity at 12 m above the bottom.

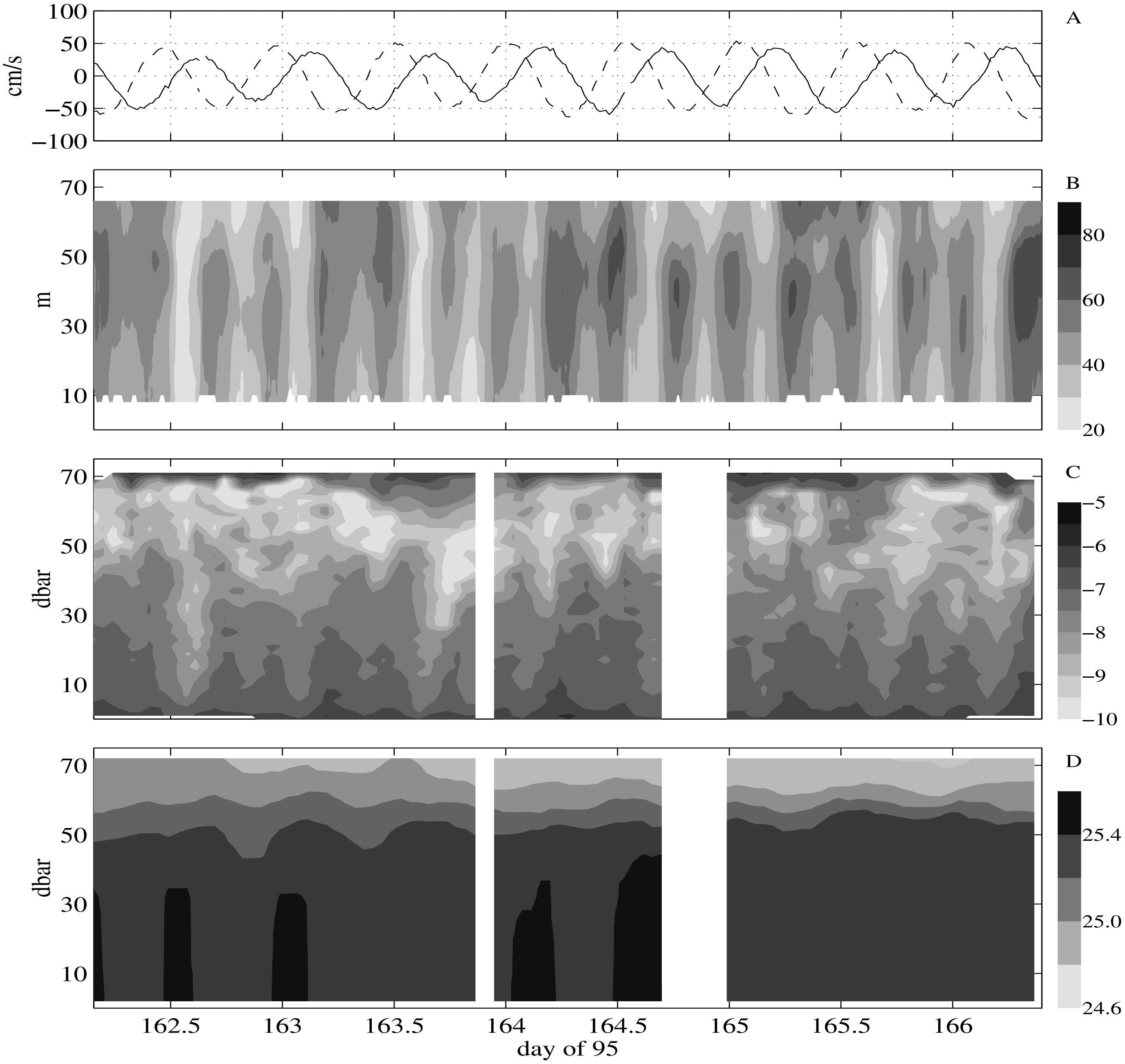

Figure 2: SJ9508 Deep site: **A:** Depth averaged (12 to 64 m height) horizontal velocity components from the broadband 150 kHz ADCP. Solid line u (east-west component), dashed line v (north-south component). **B:** Time series of horizontal velocity magnitude (cm/s) from the broadband 150 kHz ADCP. **C:** Time series of turbulent kinetic energy dissipation rate, log10(ϵ W/kg). Station averages in 2 dbar depth bins interpolated onto a one hour time grid are contoured. **D:**Time series of σ_{t} kg/m^3 from the EPSONDE CTD.